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Effectiveness of Regulatory Interventions on Firm Behavior: a Randomized Field Experiment with E-commerce Firms[1]

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Abstract

Economic regulators use a number of instruments to change the behavior of economic agents, but only limited evidence exists on the effectiveness of such regulatory interventions. We conduct a randomized field experiment to determine the effects of two interventions aimed at e-commerce firms by a regulatory authority in order to let these firms meet legal obligations regarding information disclosure to protect consumer interests. We measure the compliance behavior of e-commerce firms in both a treatment group and a control group before and after two interventions. The first regulatory intervention concerns sending personalized letters to firms (firm-specific guidance), whereas the second intervention includes a number of dedicated publications and presentations by the regulatory authority (industry guidance). We find that both of these interventions have hardly any effect, neither in the short term nor in the long term. We conclude that regulatory interventions in the form of providing only guidance on the legal rules to firms are not effective strategies to influence their behavior.

JEL classification: D21, D83, K20, M38

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1. Introduction

Assessing the effectiveness of regulatory intervention becomes increasingly relevant in the public debate on regulation of economic activities. The liberalization of markets over the past decades has relaxed regulatory constraints on the one hand (Wölfl et al., 2009), but has also resulted in more regulatory overview and enforcement of regulatory rules meant to correct market failures resulting from market power, externalities and information asymmetries. This proliferation of regulatory intervention has led to a growing need for information about its effectiveness and efficiency (Niels and Van Dijk, 2008). In particular, concerns about the costs of regulation and the risk of inappropriate measures taken by regulators call for a continuing assessment of how effective regulators operate. Prominent examples of such assessments are the policy evaluation studies conducted by the OECD. In these studies, the impact of regulatory measures on the macro-economic performance of countries is analyzed (see e.g. Nicoletti et al., 2006). Information on the effectiveness of regulation can also be helpful in the debate on the legitimacy of regulatory intervention (Don et al., 2008). Another objective of regulation-effectiveness studies is to increase our understanding of which types of interventions are when effective strategies to reach regulatory goals. Stafford (2003), for instance, analyzes the effectiveness of different types of hazardous waste regulation and finds that mandatory pollution prevention programs do not affect compliance. Other examples of this type of studies are De Witte et al. (2010) who find that a light form of price regulation of water utilities is able to foster productivity in the drinking-water industry and Nosenzo et al. (2013) who find that fines are effective in deterring non-compliance with rules, while the effect of bonuses on compliance is weak. On the topic of rule compliance, Telle (2013) concludes that frequent auditing of firms raises their compliance with environmental regulations. In an earlier study, Teller (2009) finds that just the threat of inspection, measured by the predicted probability of inspections, reduces the probability of violation of environmental rules.

Compared to the above interventions, information-related interventions constitute a mild form of regulatory intervention, as they aim to change actor behavior by just informing economic agents about the existence and contents of regulations. Limited previous research suggests such interventions to be promising. For example, Apesteguia et al. (2013) study rule compliance by individuals and analyze the effects of sending email messages to visitors of libraries based on the speed by which they return items to the library. They find that the email messages help to promote rule compliance, but the authors cannot exclude an alternative

explanation, that the email messages act as signals that the library cares about rule compliance which triggered the positive response. Iyer et al. (2010), in a study on regulatory compliance by firms, find that informing businesses by sending a letter about the enforcement strategies affects compliance. Communicating higher levels of detection raises compliance with the tax rules significantly. Both studies on information related interventions suggest that such interventions can be effective, and as they are mild and relatively easy to implement regulatory authorities may consider them attractive means to stimulate regulatory compliance.

To further increase our understanding of the effectiveness of information-related interventions, we focus on two kinds of such interventions, one that is focused on individual firms and one that aims to inform an entire industry. Our research builds on Apesteguia et al. (2013) while it is directed at firms instead of individuals, which enables us to test whether their conclusions can be extended to businesses. It complements Iyer et al. (2010), who also study firms, as we focus on the different ways of distributing information on legal rules instead of different information on enforcement strategies.

In this paper, we determine the effectiveness of two different regulatory interventions that intend to stimulate the compliance behavior of economic agents by increasing their awareness of legal obligations. More specifically, we analyze to what extent two regulatory interventions aimed at e-commerce firms by the Dutch Consumer Authority[4] are effective short-term and long-term measures to enforce legal obligations on information disclosure. According to Dutch consumer law, e-commerce firms are obliged to present various types of information that could be useful for consumers in making decisions.

Following recent research (e.g., Levitt et al., 2009; Iyer et al., 2010; Apesteguia et al., 2013; Collins, 2013), we conduct a randomized field experiment involving four measurements in which we monitor the compliance with legal obligations by online shops. Using data from the Dutch Chamber of Commerce we first define two representative samples which are used as a treatment group and a control group. In the first intervention, each firm in the treatment group receives information on the legal obligations through a personalized letter sent by the Consumer Authority, while the firms in the control group do not receive such information. Before and after this intervention we monitor the compliance of both groups of firms. The second intervention concerns the Consumer Authority providing information on the legal obligations to all firms by means of a number of dedicated publications and presentations in

[4] During the period of research, the Consumer Authority merged with the Netherlands Competition Authority (NMa) and the Independent Regulator of Telecom and Post (OPTA) into the Netherlands Authority for Consumers and Markets (ACM). For reasons of convenience, we only speak of the Consumer Authority in this paper.

public media. Again, we monitor the compliance behavior of both groups before and after the intervention.

At the baseline, about 10 to 25% of the online shops do not provide the legally required information on firm characteristics, transaction costs and the order process. Regarding two other aspects, the initial compliance of the online shops is even much worse: 60 to 70% do not provide the necessary information regarding the time window to reconsider a purchase and the payment process. With respect to the two regulatory interventions, we find that none of the interventions has a significant effect on firm behavior, neither in the short term nor in the long term. During the study period, firm compliance with the legal rules on information disclosure changed hardly, in spite of the interventions by the Consumer Authority.

The structure of this paper is as follows. Section 2 discusses the background of the regulation on information disclosure by e-commerce firms. In Section 3 we describe the field study, including the design of the randomized field experiment, the interventions, and the various measurements. Section 4 describes the data collection and the initial compliance of the online shops. Section 5 presents an overview of the effects of both interventions, while Section 6 concludes with the implications of our study and suggestions for further research.

2. Regulation of e-commerce

Technological innovations in the telecommunication industry have had major effects on consumers and producers. One of these consequences is the rapid growth in business-to-business and business-to-consumer e-commerce. The share of e-commerce in total turnover of industries was approximately 15% on average in the industrialized countries in 2012 (OECD, 2013). E-commerce appears to have a significant impact on economic growth and trade (Terzi, 2011). Buying and selling goods and services through the internet have many advantages. Online shops give buyers access to global markets with a large variety in products, while sellers can use the internet for enlarging the geographical area of their market (Grandon et al., 2004). Hence, e-commerce reduces transactions costs and increases transparency about the supply of goods and services.

A precondition for online shops to be a good alternative for consumers is that consumers can trust the information online shops provide about the characteristics of the merchandise, payment conditions, delivery process, privacy and security (Belanger et al., 2002; OECD, 2011). Customers of web shops fully depend on the information in the web site, while customers of normal (physical) shops can gather information on the quality of products by

actually experiencing (e.g. seeing, hearing, feeling) products before making a purchase decision. Moreover, customers of physical shops can deduce the trustworthiness of the shop by visiting the shop and observing and talking to the seller, while the trustworthiness of an online shop is more difficult to assess. So, while consumers always have to deal with imperfect information regarding so-called experience goods and in particular credence goods (Rischkowsky and Döring, 2008), this information asymmetry is enlarged when buying such products online. The information asymmetry may result in several inefficiencies, such as consumers buying low-quality products or refraining from buying due to a lack of confidence.

As online sellers have an interest in a positive attitude of customers regarding their merchandise, they have an incentive to provide information that may increase the trustworthiness of their shop. For the market for higher education, for instance, Mause (2010) finds that sellers have incentives to organize a quality-information system with the help of private-party intermediaries, making regulatory intervention to protect the buyers on this market unnecessary. This does not mean, however, that online sellers always have an incentive to be as informative as possible. Online sellers in particular have an incentive to choose that design of their web shop that maximizes consumer expenditures (Belanger et al., 2002). So, regulatory intervention might be needed to realize full transparency in online consumer markets.

Governments can chose from a number of options to reduce the information asymmetry, such as subsidizing private provision of product information, making the disclosure of product information legally obligatory, and protecting consumers against deceptive advertising by sellers (Mause, 2010). Regarding online shops registered in the Netherlands, the Dutch government has chosen to implement information-disclosure rules in consumer legislation. The Dutch consumer law stipulates online shops to provide information to customers regarding a number of key characteristics, including the contact details of the firm, the cost structure of purchases, the existence of a time window for reflection (to cancel a purchase), and the processes of ordering, paying and delivery (ACM, 2012). Maintaining these rules is delegated to the Consumer Authority. This authority regularly monitors whether firm' behavior is in line with consumer law. If not, the Consumer Authority has the legal power to take punishment measures, including to hand out monetary penalties. The Consumer Authority uses several instruments to influence firm behavior. One of these instruments is submitting guidance, i.e. distributing information on the contents of legal rules, the necessity to obey such rules, and the possible legal consequences of non-compliance. In this paper, we

assess to what extent such instruments are effective in raising the compliance with information-disclosure rules of e-commerce firms.

Note that improving the effectiveness of the enforcement of the legal rules on information disclosure does not necessarily imply that consumers will make better decisions. Psychological factors, as selective optimism, the endowment effect and bounded rationality, may cause that well-informed consumers make decisions which are not in their self-interest (Faure et al., 2011). The existence of these factors does, however, not imply that consumers do not benefit from measures which reduce the information asymmetry in consumers markets. Hence, searching for effective regulatory measures to reduce the information asymmetry might increase the welfare of consumers, even if they behave less rationally as is generally assumed in economic models.

3. Method of effectiveness measurement

3.1 Field experiment

The effectiveness of regulatory interventions can be measured by a number of methods. Bergman (2008) distinguishes qualitative studies, such as peer reviews, customer-satisfaction surveys and event studies, and quantitative studies, such as econometric studies on micro level or macro level. Each of these studies consists of an ex post analysis, trying to estimate the effect of past interventions on past events. A critical component of such studies is the definition of the counterfactual development, i.e. the development when the regulatory intervention would not have occurred. One way to account for counterfactual development is to conduct studies in which the circumstances affecting firm behavior are controlled. Experiments, both laboratory and field experiments, are therefore becoming more popular in economic research as they enable researchers to assess, for instance, the impact of a specific regulatory measure on firm behavior, holding all other factors equal (Levitt et al., 2009).

In a laboratory experiment, Nosenzo et al. (2013) for instance, analyze the impact of fines as well as bonuses on compliance. Although laboratory experiments can be helpful in analyzing the impact of specific interventions, the results of such an experiment cannot directly be translated into daily policy because of the constructed character of the experiment. An advantage of field experiments compared to laboratory experiments is that the former combines the advantages of a controlled laboratory experiment with realism as it works with real-life agents not knowing that they are subject to economic analysis. Field experiments are increasingly used to assess the impact of regulatory interventions. Collins (2013) analyzed the

impact of a mandatory financial education program on financial behavior of low-income families which were randomly assigned to a treatment group or a control group. Iyer et al. (2010) applied randomized field experiments to assess the effects of different enforcement strategies on compliance with tax rules. Another example is Apesteguia et al. (2013), who used randomized field experiments to analyze the effects of sending email messages to visitors of libraries on the speed by which they return the items to the library.

In this paper, we investigate the effectiveness of two regulatory interventions by conducting a field experiment similar to Collins (2013), Apestiguia et al. (2013) and Iyer et al. (2010). Below we first describe the design of the experiment, with a treatment and control group and various before and after measurements, followed by a discussion of the measurements and how these are converted into indexes.

3.2 Experimental design

The goal of this study is to determine to what extent two Consumer Authority interventions are effective in enforcing the legal obligations on information disclosure by e-commerce firms. The research design reflects a randomized field experiment in which the interventions are considered as treatments, and web shops are randomly assigned to a treatment group and a control group. The first treatment, a firm-specific guidance, entails a personalized letter to the legal owner of the web shop in which the Consumer Authority stipulates the need for compliance with the legal framework and informs the owner about possible legal consequences of non-compliance. The firm-specific guidance concerns a personalized letter that is sent to the firms in the treatment group only. The second treatment, the industry guidance, is directed at all web shops in this industry and entails a range of Consumer Authority activities, including dedicated publications, press releases, presentations, distribution of check-lists, and journal articles (see Table 1). As the industry guidance is aimed at all web shops, it is an intervention potentially impacting all firms.

Table 1

Contents of two types of guidance given by the Consumer Authority

Intervention Type	Action by the Consumer Authority
Firm-specific guidance	• Letters send to each firm of the treatment group to inform them about the legal rules, the obligation to meet these rules and the ability of the regulator to give firms a fine if they do not apply with these rules.
Industry guidance	• Publication of a document about the legal rules including links to a website of the regulator illustrating the information web shops should include. • Press release about the document and the regulator's website. Several major Dutch newspapers published this information. • A number of agencies, including the Chamber of Commerce and the Office of Tax Collectors, as well as representative bodies of (web-shop) firms placed a link on their website to the website of the Consumer Authority. • Consumer Authority representatives gave a number of presentations about the guidance and distributed check-lists during the annual web-shop days in Utrecht. • Consumer Authority representatives used Twitter and other public media to spread information about the guidance. • Launch of free-publicity campaign, which resulted in a number of news items in periodicals of representative organizations of web shops.

The data in this study reflect the extent to what web shops disclose information according to legal obligations. The data are collected for both the treatment and control group of web shops at four points in time (see Figure 1):

t=0: before sending the firm-specific guidance to the treatment group.

t=1: after sending the firm-specific guidance to the treatment group.

t=2: before distributing the industry guidance.

t=3: after distributing the industry guidance.

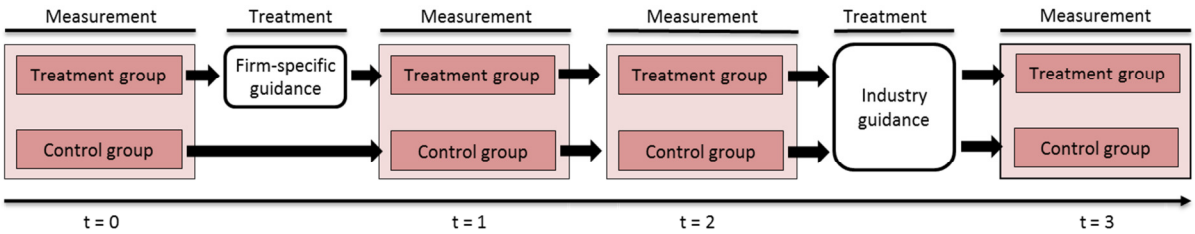

Fig. 1 The research design involving two groups, two treatments and four measurements.

The intervals between the various measurements are set to offer web shops sufficient time to respond to the treatments by changing their website. The firm-specific guidance was sent to the web shops on the next day after finalizing the t=0 measurement, the t=1 measurement took place one month after the firm-specific guidance, the t=2 measurement was done approximately 1.5 months after the t=1 measurement (which is 2.5 months after the firm-specific guidance), while the t=3 measurement took place two months after the industry guidance.

This research design enables testing of the following three effects: (a) the short-term effect of the firm-specific guidance (difference between measurements 0 and 1), (b) the long-term effect of the firm-specific guidance (difference between 0 and 2) and (c) the effect of the industry guidance (difference between 2 and 3).

The advantages of our research design include avoidance of non-compliance and self-report bias (Collins, 2013), since we observe whether information is available on a website. The observations are unobtrusive as the web shops are not informed about the measurements. The design does suffer from attrition, which is common in longitudinal research, as several websites disappeared during our study period or ceased to be a web shop. The data are collected by visiting each website to determine the availability of information elements by applying a detailed data-collection instrument (see Section 3.3). To avoid the problem of

inter-rater differences, the observations for all websites and at all time periods are done by the same researcher, who was first trained in using the data-collection instrument.

3.3 Compliance measurements

The data-collection instrument to measure the level of compliance is based on the legal framework that identifies 19 information items that should be available in a website. For each of these items, we developed an operational definition to turn the item into an observable website characteristic. The definitions are developed in collaboration with the Consumer Authority, who also approved the final data-collection instrument. The legal framework not only refers to the availability of an item, it also addresses the way as well as the place this element is implemented in a website. For example, the legal framework requires websites to be specific in referring to an item. With regard to shipping costs, the link or button to this item should be clearly mentioned as e.g. 'Shipping' or 'Delivery costs', and not be general such as 'Terms and Conditions'. The items also need to be easily found by consumers. In this example, consumers should not have to click on several subsequent links before they finally find the information on shipping costs. Therefore, the data collection instrument measures each information item on three dimensions:

- *Content:* does the website contain the item?
- *Presentation:* is the item presented clearly? (e.g., not as part of a large block of text or as fine print).
- *Place:* from the legal framework, we derived the right place in the website for each item and measure whether it is available at that place.

Each of these three characteristics is measured in a binary form: the web shop either complies with the legal rule or it does not. Compliance is coded as 1, non-compliance as 0. By aggregating over the three characteristics, we compute a compliance index, which reflects the percentage to which a web shop complies with the legal rules for an item (between 0 and 100%).[5] By using these observations, an index (Item index) is computed that reflects the percentage of web shops complying with the three characteristics of content, presentation and place:

[5] In several cases a characteristic cannot be measured, e.g. when a website does not contain an item (Content = 0). As it is impossible to observe Presentation and Place in these cases, the data are coded as missing.

$$Item\ index_i = \frac{\sum_{w=1}^{W}\sum_{d=1}^{3} M_{wdi}}{\sum_{w=1}^{W}\sum_{d=1}^{3} N_{wdi}} \quad (1)$$

In this formula *i* stands for items (1..19), *d* for the dimensions *Conten*t, *Presentation* and *Place*, w for web shops (1…W), while *N* refers to the existence of an observation (its sum represents the number of non-missing observations), and M to the measurement outcome (0 or 1). Hence, by this formula we have a score for each item for the total group of W web shops. The lowest possible index value is zero, indicating that no web shop complies on any of three dimensions. If all web shops would fully comply on all three dimensions, the value is 1 which is the maximum value of this index.

Similar to the computation of the Item Index, we also compute a Category Index. For that purpose, the 19 items are grouped into the following six categories:

1. Firm characteristics: e.g., firm name, registration number and address (5 items).
2. Additional Costs: e.g., taxes, and delivery (3 items).
3. Reflection period: e.g., whether it is offered and of sufficient duration (4 items).
4. Order process: e.g., overview of stages and products ordered (4 items).
5. Payment process: timing and deadline (2 items).
6. Delivery process: delivery method (1 item).

The formula for calculating the Category Index is:

$$Category\ index_c = \frac{\sum_{i=c}^{C}\sum_{w=1}^{W}\sum_{d=1}^{3} M_{wdi}}{\sum_{i=c}^{C}\sum_{w=1}^{W}\sum_{d=1}^{3} N_{wdi}} \quad (2)$$

In this formula c refers to the category, which consists of a number of items (i=c…C). All tables in the next sections report percentages in terms of either the Item Index or the Category Index. We use the scores on these indices to assess the effectiveness of the guidance given by the Consumer Authority.

4. Data collection

This section first describes the sampling method, i.e. the selection of the web shops for the treatment group and the control group. Next, we provide an overview of both groups, in terms

of background statistics and the extent of initial compliance, that is, the extent to which the web shops comply with legal rules before the interventions took place.

4.1 Sampling

We conduct our analysis on the industry that exploits web shops specialized in selling cloths and luxury articles. Regarding consumer online purchases, this industry is one of the most important online industries in the Netherlands. A recent report identifies this industry as being the largest in terms of online sales after Telecom subscriptions (HBD, 2013). Total 2012 sales are estimated at 730 million euro, up 16% from 2011, and up 500% compared to 2004. The sampling frame consists of all 916 web shops registered in this industry at the Dutch Chamber of Commerce on September 11, 2012. This group represents the population of this type of firms in the Netherlands.

The Chamber of Commerce data is used to sample both the treatment group and the control group. Both samples are randomly selected and compared with each other and the sampling frame in terms of age, legal status and geographical region. Age is considered to be important as web shops are a relatively new phenomenon, growing rapidly in numbers, with a 50% increase between 2010 and 2012 (Thuiswinkel.org, 2013)[6], but having a low survival rate, reportedly only 41% after four years (HVA, 2013)[7].

Determining the right sample size involves making the trade-off between statistical and practical considerations. According statistical considerations, the sample size depends on the standard deviation (σ) of the sampling variable (in this case Age[8]), the means of both the sampling frame (μ) and the sample (X), and the required confidence level (z). Taking into account the limited size of the sample framework (N), the minimum sample size (n) can be determined as follows (Malhotra 2007):

$$n = \frac{\left(\frac{\sigma^2 x^2}{(X-\mu)^2}\right)N}{\left[N+\left(\frac{\sigma^2 z^2}{(X-\mu)^2}\right)-1\right]} \qquad (3)$$

Practical considerations refer to the efforts and costs of data collection, and the fact that this study involves two groups (two samples) and four measurements for each web shop. Therefore we randomly selected 150 firms for both the treatment group and the control group,

[6] http://www.thuiswinkel.org/aantal-thuis-en-webwinkels-in-nederland.
[7] http://www.hva.nl/nieuws/2013/10/04/aantal-webwinkels-blijft-groeien-ondanks-lage-overlevingskans/.
[8] Divided into six age classes: 0 to 1.5 years, 1.5 to 3 years, 3 to 4.5 year, 4.5 to 6 years, 6 to 7.5 years and 7.5 and more years.

based on the age of the firm and formula (1), which results in a confidence level of 92%. Next, we checked whether the firms selected from the Chamber of Commerce actually represent active web shops, by visiting each of the 300 website addresses. A considerable proportion of the web shops listed in the database turned out to be unavailable, 31.7% of the 300 web shops. Therefore, we randomly added additional firms to both samples and checked these websites, until we reached 150 observable web shops for both the treatment group and the control group.

4.2 Background characteristics

To describe the treatment and the control group and to test whether the samples are also representative for other characteristics, we examine the distribution in both groups regarding legal status and geographical region (being the two characteristics available in the Chamber of Commerce database). Table 2 shows that the total sample (300 web shops) is comparable to the population in terms of age, legal status and region (chi-square tests, $p>.05$). Similar results are found when comparing the treatment group and the control group with the population data.

Table 2

Characteristics of population, sample, treatment group and control group (in %)

Characteristic	Population	Sample	Treatment group	Control group
Age (year):				
< 1.5	19.5	19.7	21.3	18.0
1.5 – 3	24.3	27.0	26.7	27.3
3 – 4.5	18.7	19.0	21.3	16.7
4.5 – 6	17.7	17.7	18.7	16.7
6 - 7.5	8.1	7.7	4.7	10.7
> 7.5	11.7	9.0	7.3	10.7
Total	100	100	100	100
Legal status:				
Sole-trader business	84.0	82.3	85.3	79.3
Partnership	12.0	14.0	12.0	16.0
Other	4.0	3.7	2.7	4.7
Total	100	100	100	100
Geographical region:				
Zuid-Holland	17.1	17.7	18.0	17.3
Noord-Holland	15.5	18.7	16.7	20.7
Noord-Brabant	12.9	12.7	14.7	10.7
Gelderland	12.2	12.7	11.3	14.0
Overijssel	8.7	6.0	5.3	6.7
Utrecht	8.1	9.7	10.7	8.7
Drenthe	5.0	4.3	4.0	4.7
Flevoland	4.9	3.0	2.7	3.3
Groningen	4.8	4.0	4.7	3.3
Friesland	4.1	5.0	4.7	5.3
Limburg	4.1	5.0	5.3	4.7
Zeeland	2.4	1.3	2.0	0.7
Total	100	100	100	100

Note: Chi-square tests show that the sample is similar to the population and the treatment group to the control group on all three characteristics ($p>.05$).

4.3 Initial compliance

The first analysis focuses on the initial compliance of the web shops in both the treatment and control group (at t=0). Table 3 shows that about 75 to 85% of the web shops score well on the requirements regarding the categories *Firm characteristics*, *Additional costs*, and *Order process*, while almost all firms fulfil the requirements regarding the *Delivery process*. As a consequence, except for the delivery process, non-compliance is not extensive but still considerable (15 to 25%).

Table 3

Results for the initial measurement (t=0), for both the treatment and control group (index in %)

Category/Item Index	Treatment group	Control group
Firm characteristics	85.3	88.9
Firm name	93.1	91.3
Registration number	65.1	71.3
Address in real world	64.4	69.1
E-mail address	68.0	79.6 *
Direct contact possibility	88.0	94.7 *
Additional Costs	76.1	75.9
Taxes	58.9	59.3
Delivery costs	82.9	85.3
Other unavoidable costs	83.3	83.3
Reflection period	30.4	31.8
Period for reflection	32.2	35.8
Duration of at least 7 days	60.7	53.9
Why reflection not relevant	2.0	0.0
Reference to legal exemption	2.0	0.0
Order process	78.7	79.2
Overview process stages	53.1	55.3
Option to reconsider	0.4	0.0
Overview ordered products	100	98.0
Option to change order	82.0	84.0
Payment process	41.3	35.9
Before/after delivery	42.0	36.4
Deadline after delivery	50.0	25.0
Delivery process	99.3	99.3
Delivery method	99.3	99.3

Note: * refers to a significant difference between the treatment and control group ($p<.05$)

With respect to the other two categories, compliance is much worse. No more than 30% of the web shops provide the appropriate information regarding the *Reflection period*, while only 41% gives sufficient information on the *Payment process*. Overall, these findings suggest ample room for improvement, which supports the idea of interventions by the Consumer Authority.

A t-test is used to compare the treatment group with the control group. Out of the 25 tests (19 items and 6 categories), only two differences are statistically significant. In both cases it concerns an item index for which the control group mean is higher than the mean for the treatment group (*E-mail address* and *Direct contact possibility*).

5. Results

This section discusses the findings with regard to (a) the short-term effects of the firm-specific guidance, which is the effect after 1 month, (b) the long-term effect of the firm-specific guidance, which is the effect after 2.5 months, and (c) the effects of the industry guidance.

5. 1 Effects of firm-specific guidance

The first two columns in Table 4 show the short-term effect of the firm-specific guidance, being the difference between the measurements at t=0 and t=1. We test whether the changes in both groups are different (t-test). Assuming the firm-specific guidance has an effect, we may expect larger positive changes in the treatment group than in the control group. Regarding the short-term effects, the treatment group does slightly better in t=1 compared to t=0 in terms of category indexes, though the largest increase is still only 3%. Compared to the control group, the treatment group shows a significantly larger increase in terms of one category index, namely *Additional costs*. Regarding the 19 item indexes, for only one of them (*Overview of the process stages*) we find a significantly larger increase for the treatment group. Overall, however, we find that the short-term effect of the firm-specific guidance is not significant in terms of most of the in total 25 indexes.

Table 4

Short-term and long-effect of firm-specific guidance (numbers are differences in index values)

	Short-term effect (Difference t=1 and t=0)		Long-term effect (Difference t=2 and t=0)	
Category/Item Index	Treatment group	Control group	Treatment group	Control group
Firm characteristics	**1.3**	**1.1**	**1.9**	**-0.0**
Firm name	0.2	3.4	1.0	3.6
Registration number	4.3	0.5	5.2	-4.3 *
Address in real world	4.8	0.0	4.0	0.7
E-mail address	-1.0	0.5	3.0	-2.1 *
Direct contact possibility	2.2	0.7	2.2	1.4
Additional Costs	**1.5**	**-1.0 ***	**1.7**	**0.0**
Taxes	1.9	-1.8	0.8	0.7
Delivery costs	1.9	-0.9	3.2	-0.2
Other unavoidable costs	n.a.	0.0	n.a	0.0
Reflection period	**-0.4**	**-2.0**	**-0.5**	**0.8**
Period for reflection	-0.5	-2.0	0.0	-0.2
Duration of at least 7 days	7.6	3.1	4.8	4.7
Why reflection not relevant	-1.2	0.0	-1.2	1.2
Reference to legal exemption	-1.2	0.0	-1.2	1.2
Order process	**3.4**	**2.4**	**3.6**	**1.1 ***
Overview process stages	11.0	2.7 *	10.0	-1.4 *
Option to reconsider	6.7	7.5	11.4	8.5
Overview ordered products	0.0	1.4	0.0	2.1 *
Option to change order	2.9	2.0	1.5	-2.1
Payment process	**1.9**	**4.5**	**-0.2**	**1.5**
Before/after delivery	1.9	5.0	0.0	1.7
Deadline after delivery	0.0	-25.0	0.0	0.0
Delivery process	**0.0**	**0.7**	**0.0**	**0.7**
Delivery method	0.0	0.7	0.0	0.7

Note: * significant difference between the Treatment and the Control group (5%, t-test, one-tailed); n.a. = not available.

The long-term effects of the firm-specific guidance are displayed in the last two columns of Table 4. Again, the absolute changes for the treatment group are most often small, in terms of category indexes all changes for this group are in the range of -0.5% and 3.6%. Only one category index shows a significant difference between both groups (*Order process*). We find a few more significant differences between both groups when considering the item indexes. Four differences are significant, three of them in the expected direction, with the treatment group outperforming the control group. These are *Registration number*, *Email address*, and *Overview order process stages*. Surprisingly, the control group shows a significantly larger

increase in terms of the item index *Overview ordered products*. Overall, again, we observe not much difference in performance between both groups, meaning that the long-term effect of the firm-specific guidance is also minimal.

5.2 Effects of industry guidance

In order to determine the impact of the industry guidance, we cannot analyze the differences between the treatment group and the control group as this guidance is provided to all firms (see Table 1). Therefore, we analyze changes in behavior over time for both groups. Panel analysis enables us to determine the change in compliance between t=2 and t=3 by controlling for other factors which may influence firm behavior, including the firm-specific guidance given to firms in the treatment group. The panel analysis is conducted at the level of the category indexes. Note that controlling for other factors was not needed in our previous analyses as the firms in the treatment group and the control group have similar characteristics while operating in the same environment.

We estimate the effect of the industry guidance by using a dummy: this dummy is set equal to 1 for all observations at t=3, and 0 for all observations at previous time periods. We include a dummy to control for the influence of the firm-specific guidance: this dummy equals 1 for all observations of the firms in the treatment group, and 0 for the control group. In addition, we control for the age and the legal status of the web shops by including these variables directly as well as by including the interaction terms between these variables and the dummies for the firm-specific and industry guidance. The latter is done because older firms and firms with a formal legal position may show better compliance with legal obligations. We include the legal status by a dummy which is 0 for firms which are a sole-trader business and 1 for all other firms. In order to control for general time effects we include a trend variable.

Table 5

Results panel analysis (n groups = 300; n time = max 4; n observations = 1124)[9]

Value of category index	Information on					
	Firm	Costs	Time for reflection	Order process	Payment process	Delivery process
constant	0.86 ***	0.75 ***	0.25 ***	0.78 ***	0.31 ***	0.99 ***
	(0.02)	(0.02)	(0.05)	(0.02)	(0.06)	(0.008)
Dummy industry guidance	-0.008	-0.02	0.04	-0.03	-0.03	-0.005
	(0.01)	(0.01)	(0.03)	(0.01)	(0.03)	(0.004)
Dummy specific guidance	0.01	-0.008	-0.001	0.01	0.11	-0.009
	(0.03)	(0.03)	(0.08)	(0.02)	(0.08)	(0.01)
Age firm	0.000009	-0.000006	0.00001	-0.000002	0.00004*	-0.000002
	(0.000007)	(0.000007)	(0.00002)	(0.000006)	(0.00002)	(0.000003)
Age firm x specific guidance	-0.00002	-0.00002	0.00001	-0.000005	-0.00003	0.000002
	(0.00002)	(0.00002)	(0.00004)	(0.00001)	(0.00004)	(0.000006)
Age firm x industry guidance	0.000001	0.000003	-0.00001	0.00002***	-0.000005	0.000002
	(0.000004)	(0.000004)	(0.00001)	(0.000004)	(0.00001)	(0.000002)
Legal status	0.06*	0.01	0.16**	0.03	-0.03	0.002
	(0.03)	(0.03)	(0.08)	(0.02)	(0.09)	(0.01)
Legal status x specific guidance	-0.06	-0.003	-0.05	0.03	-0.14	0.006
	(0.04)	(0.04)	(0.12)	(0.04)	(0.14)	(0.02)
Legal status x general guidance	-0.003	0.02	-0.07	-0.005	-0.07	-0.001
	(0.01)	(0.01)	(0.03)	(0.01)	(0.04)	(0.006)
Trend	0.004	0.005	0.002	0.01* **	0.004	0.002
	(0.003)	(0.003)	(0.008)	(0.003)	(0.009)	(0.001)

Note: between brackets the standard error; *, ** and *** refer to significance levels of 10%, 5% and 1%, respectively.

Table 5 shows that the industry guidance dummy has no significant effect on the compliance with legal rules by the web shops. For all indexes, the dummy coefficients are statistically not different from zero. The panel analysis also shows that the firm-specific

[9] The total number of observations is less than 1200 (300 firms x 4 measurements), as some web shops which were included at t=0 did not exist anymore at one or more of the following measurements. If we restrict the panel analysis to those web shops that are present in all four measurements, we find similar results.

guidance has neither a significant effect on the compliance, thereby confirming the previous analyses.

In one case (*Payment process*), the age of the web shops has a positive influence on compliance. This implies that older web shops comply to a larger extent with legal obligations with respect to information on this category. In another case (*Order process*), the age of the web fosters the compliance after the industry guidance. The results also show that the legal status has some effect on compliance. Firms with a more formal legal status (not being a 'sole-trader business') seem to comply better with the legal rules. In addition, we find that the performance of the web shops improves slightly over time, given the consistently positive coefficient of the trend, albeit this coefficient is only significant in one case (*Order process*). This is also shown by the constants of the panel regressions which are almost equal to the average values of the dependent variables at t=0 (see Table 3), this again highlights that the explanatory power of the explanatory variables is poor.

6. Conclusions

Consumer markets are known to be vulnerable for problems of information asymmetry, resulting in inefficient market outcomes. This holds in particular for online consumer markets due to the limited opportunities to experience merchandise before making a purchase decision. Because of this market failure, governments may implement a number of regulatory measures, including legal obligations regarding information disclosure. The effectiveness of such obligations depends on the strength of enforcement.

In this paper we assess the effectiveness of enforcing the legal obligations on online shops by two regulatory interventions, each informing online shops in a different way about the content and importance of legal obligations. The firm-specific guidance concerns sending personalized letters to firms, the industry guidance includes a number of dedicated publications and presentations by the regulatory authority. A randomized field experiment allowed us to determine the effectiveness of both interventions by defining a treatment group that received the personalized letter and a control group consisting of firms that did not receive a letter. Compliance with the legal rules by both groups is monitored at the baseline, i.e. before the first intervention, as well as at three different moments later on, allowing assessment of both short term and long term effects.

We find that both the firm-specific guidance and the industry guidance have hardly any effect on compliance behavior neither in the short term nor in the long term. We conclude that

regulatory interventions in the form of providing only guidance to firms are not effective strategies to influence their behavior. Firms do not seem to change their behavior in response to just receiving more information on legal obligations. Although the letter, which was personalized and sent by the Consumer Authority to each firm in the treatment group, mentions the legal power of the authority to fine non-complying firms, this threat is apparently not strong enough to have firms adapt their behavior.

This result differs from Apesteguia et al. (2013) who concluded that sending email messages with information regarding rules helps to promote compliance. One possible reason for the marked differences in intervention effectiveness is related to differences in the economic agents (firms versus individuals), since firms may make a more rational analysis of the expected costs of violating rules (Telle, 2009; 2013). More research is, however, needed to explain the absence of almost any effect of the information interventions aimed at firm compliance. Further research could focus on the reasons why economic agents do not comply. As one of the interventions included a personalized letter to the firm, not being aware of the legal obligations cannot explain non-compliance behavior in our study. A more in depth understanding of non-compliance behavior will help regulatory authorities in designing effective interventions.

Based on our findings, we formulate the following implications for regulatory authorities. First, although regulatory authorities need to inform economic agents about legal obligations, they also need to realize that just informing economic agents may be insufficient to change their behavior. In addition to communicating the legal obligations and the regulator's ability to fine, more serious regulatory threats are needed in order to have a significant influence on firm behavior (Iyer et al., 2013). Second, regulatory authorities may consider more creative interventions that could be effective as they have important consequences for the economic agents. For example, the regulatory authority in our study may consider involving consumer-advocate organizations and even individual consumers in interventions. Consumer advocate organizations could report scores (rankings) of firms complying with a varying extent to legal obligations (for example by using our measurement model), while consumers could adjust their purchase behavior in response to such information. The resulting bad publicity and missing sales may be effective in changing firm behavior. Such an intervention can be effective as the experience of the Dutch drinking-water industry shows. Publicizing data on the relative performance of firms motivated them to improve efficiency (De Witte et al., 2010).

Third, research into the effectiveness of government interventions may benefit from adopting our randomized field experimental design. Following and extending previous effectiveness studies based on field experiments (e.g., Apesteguia et al., 2013; Collins, 2013; Iyer et al., 2013), we have shown that such a design is a powerful, accurate and realistic way to study how effective interventions are. The distinction between a treatment and control group allows researchers to control for changes in the environment that are beyond control of the researcher but that could affect intervention effectiveness.

Although regulatory interventions are found in many situations and in many forms, we still lack knowledge with regard to their effectiveness and efficiency (Niels and Van Dijk, 2008). This paper provides clear evidence that at least not all interventions are effective. Both information-related interventions were ineffective in changing the behavior of economic agents. In combination with the importance of regulatory interventions for national economic policies and the current lack of understanding of their effectiveness, more field research is needed to explore this issue.

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